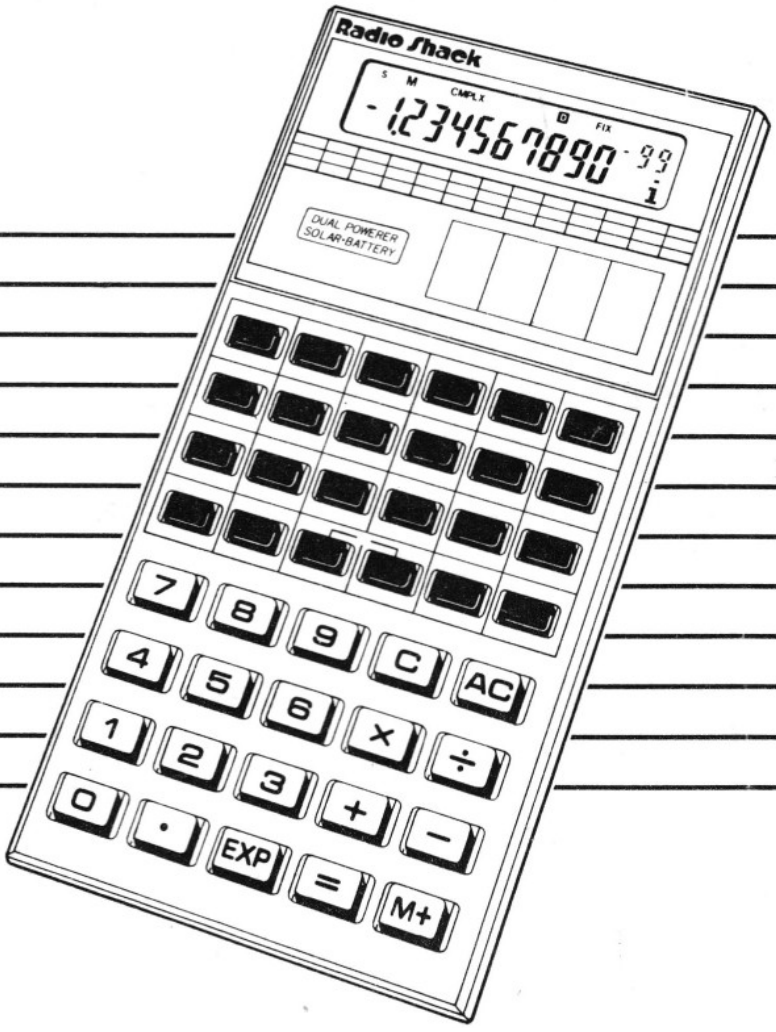
EC-4032

OWNER'S MANUAL

SCIENTIFIC CALCULATOR

PLEASE READ BEFORE USING THIS EQUIPMENT



Cat. No. 65-998

Radio Shack®

INTRODUCTION

Your Radio Shack EC-4032 Scientific Calculator is one of the most complete and compact calculators available.

Your calculator helps you solve problems in anything from basic math to trigonometry, statistics, binary/octal/hexadecimal conversions, and even complex number calculations. It judges which arithmetic operation must be performed first, using algebraic logic, and lets you use up to 18 parentheses at six levels.

Your calculator features:

Dual Power Sources — let you use your calculator anywhere. If there is enough light, the solar cell provides power. Otherwise, the calculator's lithium battery powers your calculator.

Engineering Symbol Functions — let you calculate with unit symbols for kilo, Mega, Giga, milli, micro etc.

Complex Number Calculations — let you perform real and imaginary number calculations.

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Rugged Plastic Case — helps to protect your calculator from rough handling, making it ideal for the student, engineer, or businessman on-the-go.

Seven Constant Memory Registers — hold information for later use, even after you have turned off the calculator.

Conversion Functions — allow you to convert fractions to decimals, degrees/hours, minutes, and seconds to decimal format and back, and polar-to-rectangular and rectangular-to-polar coordinates.

Base 2, 8, and 16 Functions — let you perform logical math and conversions between the bases.

Trigonometric Functions — let you perform sine, cosine, tangent, arcsine, arcosine, arctangent, and all hyperbolic functions using either degrees, radians, or gradients as the basic units.

Logarithmic Functions — provide quick access to log base-10 and natural logarithms (base-e).

Statistical Functions — include both standard deviation calculations and linear regression analysis calculations.

Probability Functions — let you quickly determine the number of permutations and combinations for a set.

We want your EC-4032 calculator to become your problem-solving right hand! Following the examples in this manual is the first step toward that goal.

You do not have to read the entire manual if you are interested in only one operation or procedure. We suggest that you read "Basic Operations" first so that you can become familiar with your calculator. Then, review the contents. When you identify an operation you want to perform, turn to that page. There you find procedures and other supporting information such as calculation accuracy or allowable input range.

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BASIC OPERATIONS

POWER

Put your thumb on the latch at the bottom of your calculator and release it to open the cover. Press AC ON to turn on the unit. 0. appears on the display.

When you are through, close the cover. You don't need to turn off the calculator; it automatically turns off in about 6 minutes. Even when the power is off, the memory contents — both independent and constant — and mode setting are retained.

The EC-4032 features a unique system. The built-in lithium battery takes over when there is not enough light to power the solar cell. You can operate the calculator anywhere, even in complete darkness; no need to worry about the light conditions. The lithium battery also protects memories when the calculator is off.

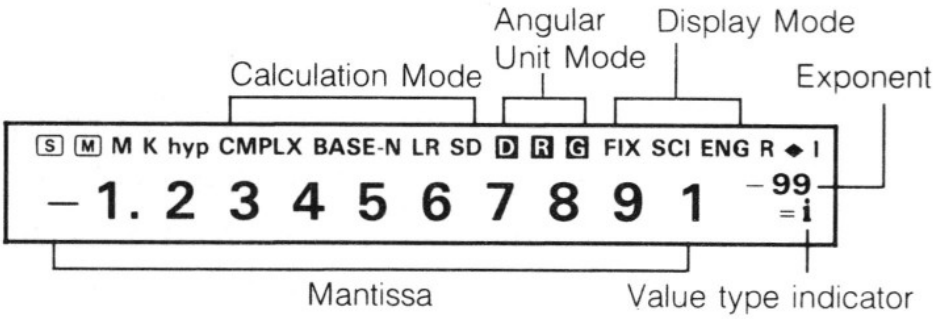
Typically, the lithium battery lasts for six years. When the lithium battery gets weak, the memory contents might spontaneously clear or the display darkens in poor light and cannot be restored by pressing the AC ON key. When such symptoms occur, bring the unit to your local Radio Shack store for battery replacement.

Note: Replacement of a lithium battery requires special attention. Do not try to replace the battery yourself.

Auto Power-Off

If you leave the calculator on and do not press a key for 6 minutes, the calculator turns off automatically to conserve battery power. To turn on the unit again, press the AC ON key.

DISPLAY


Angular Unit Mode
Display Mode
Calculation Mode
Exponent
S M M K hyp CMPLX BASE-N LR SD D R G FIX SCI ENG R ◆ I
– 1. 2 3 4 5 6 7 8 9 1
– 99
=i
Mantissa
Value type indicator

The display can show a mantissa of up to 10 digits and an exponent of up to two digits.

-E- or -C-	Error indication.
S	You pressed SHIFT.
M	You pressed MODE.
M	Something is in the memory.
K	A constant is set.
hyp	You pressed hyp.
CMPLX	Complex number calculation.
BASE-N	Base-N mode.
LR	Regression analysis calculation.

SD	Standard deviation calculation.
D or R or G	Angular unit.
FIX	Decimal places specified.
SCI	Significant digits specified.
ENG	Engineering symbol mode.
R ◆ I	Real and imaginary parts exist.
i	Displayed value is imaginary part.
45⌟12⌟23.	45-12/23 (See "Fractions.")
12°3°45.6	12°3'45.6" (See "Digital Notation and Degrees-Minutes-Seconds Notation.")
r or θ	Length/angle in polar coordinate mode.
x or y	Coordinates in rectangular coordinate mode.
f, p, n, μ, m, k, M, G, T	Unit displays in engineering symbol mode.

You will find more detailed explanations with the related functions later in the manual.

SPECIAL KEYS

This section describes five special keys that affect the overall operation of the EC-4032.

SHIFT Key

In order to keep your calculator as compact as possible, each key has more than one function. You can change the main function to the secondary function (printed in brown next to the key) by pressing [SHIFT]. Press [SHIFT]. [S] appears on the display. Then, press a function key. The function printed in brown is performed, and the [S] disappears from the display. Press [SHIFT] a second time to cancel.

MODE Key

To put your calculator into a desired mode, press [MODE] first, followed by a number key ([0], [1]...[9], [•], or [EXP]). As shown below, there are different groups of modes. The EC-4032 is always in one mode from each of the three groups. For example, under normal operation the EC-4032 would be in the COMP operation mode ([MODE] [0]); either DEG, RAD, or GRA trigonometric unit mode ([MODE] [4], [5], or [6]); and the NORM display mode ([MODE] [9]).

Calculation Modes

[MODE] [0] — COMP mode. Carry out ordinary arithmetic and functional calculations. Press to cancel the base-N,

standard deviation, or linear regression mode.

MODE 1 — BASE-N mode. Carry out binary/octal/decimal/hexadecimal conversions, calculations, and logical operations. See "Binary, Octal, Decimal and Hexadecimal."

MODE 2 — LR is displayed. Calculate linear regression analysis. See "Regression Analysis" under "Statistical Calculations."

MODE 3 — SD is displayed. Calculate standard deviation. See "Means and Standard Deviations" under "Statistical Calculations."

MODE EXP — CMPLX is displayed. Carry out complex number calculations. See "Complex Number Calculations."

Angular Unit Modes

MODE 4 — Set the angular mode, used for trigonometric calculations, to degrees. **D** is displayed. See "Angular Modes."

MODE 5 — Set the angular mode to radians. **R** is displayed.

MODE 6 — Set the angular mode to grads. **G** is displayed.

Display Modes

[MODE] [7] — Sets the display to show a specified number of decimal places. FIX is displayed. See "Setting Decimal Places" under "General Information."

[MODE] [8] — Sets the display to show the specified number of significant digits. SCI is displayed. See "Setting Significant Digits" under "General Information."

[MODE] [9] — Cancels FIX or SCI setting. This operation also changes the range of the exponent display (see page 19).

[MODE] [•] — ENG is displayed. Carry out calculation using engineering unit symbols. See page 20.

Sign-Change Key

Press the [+/−] key to change the sign of the displayed value.

Press it after pressing [EXP] to change the sign of the exponent.

Parentheses

If you want the EC-4032 to perform a calculation normally of a lower priority before performing another, place the lower-priority calculation in parentheses. You can have up to six levels of parentheses (parenthetic expressions within parenthetic expressions).

The number of parentheses displays.

Pi Key

To enter the value π (the ratio of the circumference of a circle to its diameter), press [EXP] without entering a number. The value of π (to 9 decimal places) appears on the display along with the π symbol on the lower right of the display.

GENERAL INFORMATION

Priority of Calculations

Your EC-4032 observes true algebraic logic. This means that it performs calculations in the following order:

1. Parenthetic expressions, starting with the innermost parentheses and working to the outermost. For example, assume you enter:
   $(3+4)\times((3+5)-5)$

   The calculator performs the calculations in the following order.
   $\underline{(3+4)}\times(\underline{(3+5)}-5)$
   $7\times\underline{(8-5)}$
   7×3
   The result is 21.
2. Immediate functions (functions that immediately affect the value in the display), such as x^2, $x!$, sin and cos.

3. Two value functions, such as x^y, P→R, nPr and so on. You must press [=] to complete the function.
4. Multiplication, division.
5. Addition, subtraction.

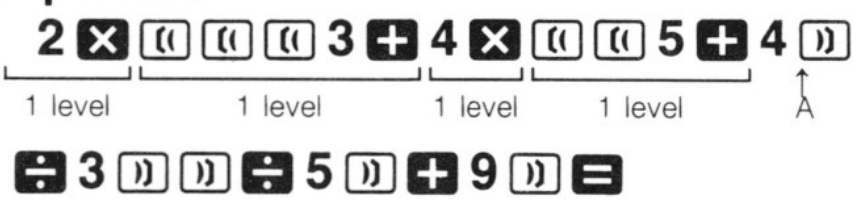
Operations with the same precedence are performed in the order you input them.

The calculator has six calculation registers, L_1 through L_6, for storing operations of lower priority (including parenthetic operations). When the calculator encounters an operation of higher priority, it "pushes" the lower priority operation into the higher register. After the higher priority operation is over, the calculator "pops" out the pending lower priority operation from the register and performs it. Since there are six registers, the calculator accepts up to six levels of pending operations.

Each level can contain up to three open parentheses, so parentheses can be nested up to 18 times.

Example: (4 levels, 5 nested parentheses)

Operation



÷ 3)))) ÷ 5)) + 9)) =

Register contents at point A.

x^*	4
L_1	[([(5 +
L_2	4 ×
L_3	[([([(3 +
L_4	2 ×
L_5	
L_6	

*x is the display register.

Correcting Mistakes

If you press the wrong number key, press **C**, and enter the correct number. The previous calculations remain intact, and you can carry on the calculations. Or you can correct the last digit entered by pressing ►. This erases the last digit on the display, and the display shifts to the right one place. For example, to change 123 to 124:

123	123. ►	12.
4	124.	

If you press an incorrect immediate function key, you must re-enter your calculation.

Setting Decimal Places (Using FIX)

Use the FIX function to specify the number of digits to be displayed after the decimal point. The calculator continues to calculate using the full 12 digits even though it displays only the number of digits you specify.

Press [MODE] [7], followed by the number of digits (0 ~ 9). FIX appears on the display, and the displayed value is rounded to the number of digits you specify. To cancel this function, press [MODE] [9].

Example:		
	20 ÷ 7 =	2.857142857
	[MODE] [7] [2]	2.86
	[MODE] [9]	2.857142857

Setting Significant Digits (Using SCI)

The SCI function is similar to FIX, but SCI specifies the total number of significant digits to display. The calculator continues to calculate using the full 12 digits even though it displays only the number of digits you specify.

Press [MODE] [8], followed by the number of significant digits (0 ~ 9). SCI appears on the display, and the displayed value is rounded to the number of significant digits you specify. To cancel this function, press [MODE] [9].

Example:

614 ÷ .0056 =	109642.8571
[MODE] [8] [3]	1.10^{05}
(rounded off to 3 significant digits)	
[MODE] [9]	109642.8571

Rounding Off (Using RND)

As mentioned above, even though you specify the number of digits to display, the calculator continues to use 12 digits for the calculations. To set the number that the calculator uses for calculation to be equal to the number on the display when using the FIX or SCI mode, press [SHIFT] [RND].

Example:	**20 ÷ 7 =**	2.857142857
	[MODE] [7] [2]	2.86
	[SHIFT] [RND]	2.86
	[x^2]	8.18

Compare with following

	20 ÷ 7 =	2.857142857
	[MODE] [7] [2]	2.86
	[x^2]	8.16

Errors

The calculator indicates an overflow or error by displaying -E- or -E- sign and stopping further calculation.

Overflow or error occurs:

a) When an answer (whether intermediate or final) or an accumulated total in the memory, is more than 1×10^{100} (-E- appears).
b) When function calculations are performed with a number exceeding the input range (-E- appears).

c) When the ranges for any of the number systems used in the BASE-N mode are exceeded (-E- appears).
d) When unreasonable operations are performed in statistical calculations (-E- appears).
e) When the total number of levels of explicitly and/or implicitly (with addition-subtraction versus multiplication-division including x^y and $x^{1/y}$) nested parentheses exceeds six, or more than 18 pairs of parentheses are used (-E- appears).

Example: You pressed the [(▪▪▪)] key 18 times continuously before designating the sequence of [2] [2] [+] [3] [×].

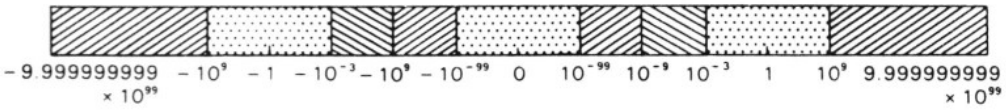
To recover from these errors:

a), b), c), d) ... Press [AC].
e) ... Press [AC]. Or, press [C]; the intermediate result just before the overflow occurs displays and you can continue the calculations.

Memory protection:

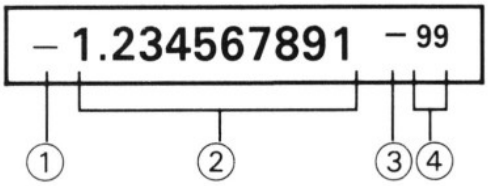
The memory contents are protected against overflow or error. You can recall the accumulated total by pressing [MR] after pressing [AC] to clear the overflow or error.

SCIENTIFIC NOTATION



Normal display
Scientific notation
Normal display/Scientific notation

If the result of a calculation exceeds the normal display capacity, it is automatically displayed using scientific notation, 10-digit mantissa and exponents of 10 up to ±99. When the calculation result is between −3 and −9 of exponent of 10, you can switch the calculation result between normal display and scientific notation by pressing [MODE] [9].



① The minus (−) sign for mantissa
② The mantissa
③ The minus (−) sign for exponent
④ The exponent of ten

The whole display is read:

$$-1.234567891 \times 10^{-99}$$

*To enter a value using scientific notation, enter the mantissa, press [EXP], and then enter the exponent.

EXAMPLE	OPERATION	READ-OUT
$-1.234567891 \times 10^{-3}$		
$(= -0.001234567891)$		
	1.234567891 [+/-]	-1.234567891
	[EXP]	$-1.234567891\ 00$
	3 [+/-]	$-1.234567891\ -03$

Engineering Display

To change the displayed number so that it is shown with exponents of 10 that are multiples of 3, use the [ENG] or [$\overleftarrow{\text{ENG}}$] key. [ENG] converts the displayed number to smaller units and [$\overleftarrow{\text{ENG}}$] converts to larger units.

Example:

12.3456		12.3456
	[ENG]	12.3456 00
	[ENG]	12345.6 −03
	[ENG]	12345600. −06
	[ENG]	12345600. −06 (no change)
12.3456		12.3456
	[$\overleftarrow{\text{ENG}}$]	0.0123456 03
	[$\overleftarrow{\text{ENG}}$]	0.000012345 06
	[$\overleftarrow{\text{ENG}}$]	0.000000012 09
	[$\overleftarrow{\text{ENG}}$]	0.000000012 09 (no change)
	[ENG]	0.000012345 06
	[ENG]	0.0123456 03

You can also use the symbol mode. In this mode, a symbol appears instead of the exponent of 10.

To select the symbol mode, press MODE •. ENG appears on the display. To exit the engineering symbol mode, press MODE • again. ENG disappears from the display.

Unit	Engineering Symbol
10^{-15}	f (femto)
10^{-12}	p (pico)
10^{-9}	n (nano)
10^{-6}	μ (micro)
10^{-3}	m (milli)
10^{3}	k (kilo)
10^{6}	M (Mega)
10^{9}	G (Giga)
10^{12}	T (Tera)

In this mode, the EC-4032 automatically displays the normal calculations results with an engineering symbol that gives the result within the range of 1 to 1000.

To enter a value using the engineering symbol, press SHIFT followed by the unit symbol key (printed upper left of the numeral keys).

EXAMPLE	OPERATION	READ-OUT
100m (milli) × 5μ (micro) = 500n (nano)		
	MODE •	
	100 SHIFT m **× 5** SHIFT μ **=**	500.n
9 ÷ 10 = 0.9 = 900m (milli)		
	9 ÷ 10 =	900.m
	(Continuing) ENG	0.9
	(Continuing) ENG	900.m

If you press a symbol key without specifying a value, a value of 1 is automatically entered.

1k (kilo) × 1k (kilo) = 1M (Mega)

SHIFT k × = 1.M

When the result is outside the range of the symbol display, the calculator uses exponential display.

1T (Tera) × 1G (Giga) = 10^{21}

SHIFT T × SHIFT G = $1.^{21}$

Notes:

- You cannot use unit symbols for fractions.
- You can also use the unit symbol keys in the normal calculation mode.
  However, the calculation results appear in normal display format.

Example:

300m × 6k = 1800

MODE 0	
300 SHIFT m	300.m
×	0.3
6 SHIFT k	6.k
=	1800.
MODE •	1.8k

FOUR BASIC CALCULATIONS
(+, −, ×, ÷)

Select the normal calculation (COMP mode) by pressing MODE 0. Calculations are performed in the same sequence as the written formula designates. You can nest up to 18 parentheses at six levels.
The calculation range allows 10 digit mantissa plus a 2-digit exponent up to $10^{\pm 99}$

Example:

EXAMPLE	OPERATION	READ-OUT
$23+4.5-53=$	**23 + 4.5 − 53 =**	−25.5
$7\times 8-4\times 5(=56-20)=$	**7 × 8 − 4 × 5 =**	36.

Sign Change

$56\times(-12)\div(-2.5)=$

56 × 12 +/− ÷ 2.5 +/− = 268.8

Constant

Press one of the four basic calculation keys (+, −, ×, ÷) twice to store the displayed value as a constant. K appears on the display to indicate that a value is stored as a constant.

Example:

EXAMPLE	OPERATION	READ-OUT
$3+2.3=$	**2.3 + + 3 =** K	5.3
$6+2.3=$	**6 =** K	8.3

$2.3 \times 12 =$	**12 × × 2.3 =** K	27.6
$(-9) \times 12 =$	**9 +/- =** K	−108.
$7 - 5.6 =$	**5.6 − − 7 =** K	1.4
$-4.5 - 5.6 =$	**4.5 +/- =** K	−10.1
$74 \div 2.5 =$	**2.5 ÷ ÷ 74 =** K	29.6
$85.2 \div 2.5 =$	**85.2 =** K	34.08
$1.7^2 =$	**1.7 × × =** K	2.89
$1.7^3 =$	**=** K	4.913
$1.7^4 =$	**=** K	8.3521
$3 \times 6 \times 4 =$	**3 × 6 × ×** K	18.
	4 = K	72.
$3 \times 6 \times (-5) =$	**5 +/- =** K	−90.
$\frac{56}{4 \times (2+3)} =$	**4 × (2 + 3**	
	) ÷ ÷ K	20.
	56 = K	2.8
$\frac{23}{4 \times (2+3)} =$	**23 =** K	1.15

The calculator stores the constant in the Y register. You can check the constant by pressing the SHIFT X↔Y key. See "Register Exchange."

Parentheses

Example:

EXAMPLE	OPERATION	READ-OUT	
$2\times\{7+6\times(5+4)\}=$			
	2 ×	[01	0.
	7 + **6** ×	[02	0.
	5 + **4**)) =		122.

You can omit closing parentheses if they come immediately before the = key.

EXAMPLE	OPERATION	READ-OUT
$10-\{7\times(3+6)\}=$		
	10 − **7** × **3** + **6** =	−53.

Register Exchange (X↔Y)

SHIFT X↔Y exchanges the displayed number (X register) with the contents of the working register (Y register). This means that you can reverse a division problem so that A ÷ B becomes B ÷ A. This feature is convenient if the denominator of a fraction contains multiplication or division. The numerator must not contain any operations.

Example:

EXAMPLE	OPERATION	READ-OUT
$\frac{7.4}{1.23\times4.56\div2}=$		
	1.23 × **4.56** ÷ **2** ÷	2.8044
	7.4 SHIFT X↔Y =	2.638710598

Fractions

You can enter fractions such as $3\frac{1}{4}$ as they are written instead of having to convert them to improper fractions. Enter the integer parts, press [a b/c], enter the numerator, press [a b/c], and then enter the denominator.

Note that the "⌟" takes one digit on the display. This limits the range of an input fraction to a total of eight digits. If the calculation's result exceeds this limit, the calculator automatically shows the answer in decimal.

If you want the answer displayed in decimal form, press [a b/c] after the answer is obtained. Pressing [a b/c] again converts the answer back into a fraction.

Note: You cannot convert a decimal entry or answer to a fraction.

Example:

EXAMPLE	OPERATION	READ-OUT
$4\frac{5}{6}\times(3\frac{1}{4}+1\frac{2}{3})\div 7\frac{8}{9}=$		
	4 [a b/c] 5 [a b/c] 6 [×] [(] 3 [a b/c] 1 [a b/c] 4 [+]	
	1 [a b/c] 2 [a b/c] 3 [)] [÷] 7 [a b/c] 8 [a b/c] 9 [=]	3⌟7⌟568.
	[a b/c]	3.012323944
	[a b/c]	3⌟7⌟568.
$2\frac{4}{5}+\frac{3}{4}-1\frac{1}{2}=$		
	2 [a b/c] 4 [a b/c] 5 [+] 3 [a b/c] 4 [−]	3⌟11⌟20.
	[a b/c]	3.55
	1 [a b/c] 1 [a b/c] 2 [=]	2⌟1⌟20.

$$(1.5\times10^{7})-\{(2.5\times10^{6})\times\frac{3}{100}\}=$$

1.5 EXP **7** − **2.5** EXP **6**
× **3** a b/c **100** = 14925000.

When you enter an operator or press = the entered fraction is automatically converted to a proper fraction reduced to its lowest common denominator.

Example:

EXAMPLE	OPERATION	READ-OUT
$3\frac{456}{78}=8\frac{11}{13}$ (Reduction)		
	3 a b/c **456** a b/c **78**	3⌟456⌟78.
	=	8⌟11⌟13.

Or, you can make it an improper fraction by pressing SHIFT d/c.

Continuing from above

	SHIFT d/c	115⌟13.

If any operand is decimal, the answer is shown in decimal form.

EXAMPLE	OPERATION	READ-OUT
$\frac{41}{52}\times78.9=$	**41** a b/c **52** ×	41⌟52.
	78.9 =	62.20961538

Percentage

To find a percentage of a number, enter the number first, then press ×, the percentage amount, and SHIFT %. For a percent increase on the answer (markup), press + after SHIFT %. For a percent reduction (discount), press −.

Example:

EXAMPLE	OPERATION	READ-OUT
12% of 1500	**1500 × 12** SHIFT %	180.
Percentage of 660 against 880	**660 ÷ 880** SHIFT %	75.
15% add-on to 2500	**2500 × 15** SHIFT % +	2875.
25% discount from 3500	**3500 × 25** SHIFT % −	2625.

300cc is added to a 500 cc solution. What is the percent of the new volume to the initial one?

300 + 500 SHIFT % 160.

If you made $80 last week and $100 this week, what is the percent increase?

100 − 80 SHIFT % 25.

Using constant to calculate:

EXAMPLE	OPERATION	READ-OUT
12% of 1200	**1200 × × 12 SHIFT % K**	144.
18% of 1200	**18 SHIFT % K**	216.
23% of 1200	**23 SHIFT % K**	276.
26% of 2200	**26 × ×**	
	2200 SHIFT % K	572.
26% of 3300	**3300 SHIFT % K**	858.
26% of 3800	**3800 SHIFT % K**	988.

30 is ?% of 192
156 is ?% of 192

192 ÷ ÷ 30 SHIFT % K	15.625
156 SHIFT % K	81.25

600 grams was added to 1200 grams. What percent is the total to the initial weight?
510 grams was added to 1200 grams. What percent is the total to the initial weight?

1200 + + 600 SHIFT % K	150.
510 SHIFT % K	142.5

How many percent down is 138 grams from 150 grams?
How many percent down is 129 grams from 150 grams?

150 − − 138 SHIFT % K	−8.
129 SHIFT % K	−14.

MEMORY CALCULATIONS

Standard Memory

Standard memory is the independent memory available on most calculators. The calculation range allows a 10-digit mantissa and a 2-digit exponent of up to $10^{\pm 99}$.

[Min] ..... (memory in) stores the displayed value into memory, clearing the previous contents.

[M+] ..... (memory add) adds the displayed value or result of a pending calculation to the value in memory.

[SHIFT] [M−] ..... (memory subtract) subtracts the displayed value or result of a pending calculation from the value in memory.

[MR] ..... (memory recall) recalls the contents of memory to the display.

When you have stored a value in memory, M appears on the display. The contents are preserved even after you turn off the power. To clear the memory contents, press [AC] [Min].

Example:

EXAMPLE	OPERATION	READ-OUT
53 + 6 = 59	**53 [+] 6 [=] [Min]**	M 59.
23 − 8 = 15	**23 [−] 8 [M+]**	M 15.
56 × 2 = 112	**56 [×] 2 [M+]**	M 112.
99 ÷ 4 = 24.75	**99 [÷] 4 [M+]**	M 24.75
210.75	[MR]	M 210.75

$7+7-7+(2\times3)$
$+(2\times3)+(2\times3)-(2\times3)=$

7 [Min] [M+] [SHIFT] [M−]
2 [×] **3** [M+] [M+] [M+] [SHIFT]
[M−] [MR] M 19.

$12\underline{\times3}=36$
$-)\ 45\underline{\times3}=135$
$78\underline{\times3}=234$
135

3 [×] [×] **12** [=] [Min] M K 36.
45 [SHIFT] [M−] M K 135.
78 [M+] M K 234.
[MR] M K 135.

Constant Memories

There are six constant memories. Use them to store numbers you use often in your calculations.

[Kin] ..... (constant in) Press a number key ([1] — [6]) to select the constant memory to use. The calculator stores the displayed value in that memory, clearing the previous contents.

[Kout] ..... (constant out) Press a number key ([1] — [6]) to select the constant memory to recall. The number stored in that memory displays.

[SHIFT] [KAC] ..... clears all constant memories.

[SHIFT] [X↔K] ..... (constant memory exchange) Press a number key ([1] — [6]) to exchange the displayed value (X register) with the contents of that constant memory (K1-6 register).

To clear only one constant memory, press AC Kin and the number of the memory you wish to clear (1 — 6). The contents of constant memories are preserved even after you turn off the calculator.

Example:

EXAMPLE	OPERATION	READ-OUT
$193.2 \div 23 =$	**193.2** Kin 1 ÷ **23** =	8.4
$193.2 \div 28 =$	Kout 1 ÷ **28** =	6.9
$193.2 \div 42 =$	Kout 1 ÷ **42** =	4.6
$\frac{9 \times 6 + 3}{(7-2) \times 8} =$	**9** × **6** + **3** = Kin 1	57.
	((**7** − **2**)) × **8** = Kin 2	40.
	Kout 1 ÷ Kout 2 =	1.425

You can perform arithmetic calculations on the contents of the constant memories. Press the appropriate operator key before pressing the memory location number. That is, press Kin + 1 to add the displayed value to Constant Memory 1. The displayed value is not affected.

Example:

EXAMPLE				OPERATION	READ-OUT
	$7\times$	$8\times$	$9=504$		
	$4\times$	$5\times$	$6=120$		
	$3\times$	$6\times$	$9=162$		
(Total)	14	19	24	786	

7 [Kin] [1] [×] **8** [Kin] [2] [×] **9** [Kin] [3]
[=] [Min] M 504.
4 [Kin] [+] [1] [×] **5** [Kin] [+] [2] [×] **6**
[Kin] [+] [3] [M+] M 120.
3 [Kin] [+] [1] [×] **6** [Kin] [+] [2] [×] **9**
[Kin] [+] [3] [M+] M 162.
[Kout] [1] M 14.
[Kout] [2] M 19.
[Kout] [3] M 24.
[MR] M 786.

Register Exchange (X↔K)

Exchanges the displayed number (4.5) with the contents of Constant Memory 1.

Example:

EXAMPLE	OPERATION	READ-OUT
$12\times(\underline{2.3+3.4})-5=$		
$30\times(\underline{2.3+3.4}+\underline{4.5})-15\times\underline{4.5}=$		
12 [×] [(] **2.3** [+] **3.4** [)] [Kin] [1] [−] **5** [=]		63.4
30 [×] **4.5** [Kin] [+] [1] [SHIFT] [X↔K] [1] [−] **15**		
[×] [Kout] [1] [=]		238.5

BINARY, OCTAL, DECIMAL AND HEXADECIMAL

You can perform binary, octal, decimal and hexadecimal calculations and conversions by placing the calculator in the BASE-N mode.

To select the BASE-N mode, press [MODE] [1]. BASE-N and d, o, b, or H appears on the display.

To select the base, press the [DEC], [HEX], [SHIFT] [BIN], or [SHIFT] [OCT] key.

Calculation range

BASE	DIGITS	RANGE
Binary	10 digits	
	Positive:	$0 \leqq x \leqq 111111111$
	Negative:	$1000000000 \leqq x \leqq 1111111111$
Octal	10 digits	
	Positive:	$0 \leqq x \leqq 3777777777$
	Negative:	$4000000000 \leqq x \leqq 7777777777$
Decimal	10 digits	
	Positive:	$0 \leqq x \leqq 2147483647$
	Negative:	$-2147483648 \leqq x \leqq -1$
Hexa-decimal	8 digits	
	Positive:	$0 \leqq x \leqq 7FFFFFFF$
	Negative:	$80000000 \leqq x \leqq FFFFFFFF$

Valid values

BASE	VALUES
Binary:	0, 1
Octal:	0, 1, 2, 3, 4, 5, 6, 7
Decimal:	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Hexadecimal:	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

You cannot enter values other than noted above while each respective base is in effect. The letters B and D displays in lower case for hexadecimal.

The keys used in this mode have their function names printed in green above them. As you might have noticed, the advanced function keys do not operate in this mode, even if you set the base as decimal. Memory and parentheses calculations can be performed, as well as the four basic calculations.

You cannot enter decimal fractions in this mode. If the calculation's result causes a fraction, the calculator automatically rounds the fraction to an integer.

Binary / Octal / Decimal / Hexadecimal Conversions

EXAMPLE	OPERATION	READ-OUT
[MODE] [1] (BASE-N mode)		
Conversion of 22_{10}		
to binary	[DEC] **22** [SHIFT] [BIN]	10110.^{b}
to octal	[SHIFT] [OCT]	26.^{o}
to hexadecimal	[HEX]	16.^{H}
Conversion of 513_{10}		
to binary	[DEC] **513** [SHIFT] [BIN]	-E-^{b}

Conversion might sometimes be impossible if the calculation range of the original value is greater than the range of the result value.

EXAMPLE	OPERATION	READ-OUT
Conversion of $7FFFFFFF_{16}$ to decimal		
	[HEX] **7FFFFFFF** [DEC]	2147483647.^{d}
Conversion of 4000000000_{8} to decimal		
	[SHIFT] [OCT] **4000000000** [DEC]	−536870912.^{d}
Conversion of 123456_{10} to octal		
	[DEC] **123456** [SHIFT] [OCT]	361100.^{o}
Conversion of 1100110_{2} to decimal		
	[SHIFT] [BIN] **1100110** [DEC]	102.^{d}

Negatives

To obtain a negative value, press [NEG]. The calculator calculates two's complement of the value on the display for binary, octal and hexadecimal numbers.

EXAMPLE	OPERATION	READ-OUT
	[MODE] [1] (BASE-N mode)	
Negation of 1010_2		
	[SHIFT] [BIN] **1010** [NEG]	1111110110.^{b}
Conversion to decimal	[DEC]	−10.^{d}
Negation of 1_2	[SHIFT] [BIN] **1** [NEG]	1111111111.^{b}
Negation of 2_8	[SHIFT] [OCT] **2** [NEG]	7777777776.^{o}
Negation of 34_{16}	[HEX] **34** [NEG]	FFFFFFCC.^{H}

Binary/Octal/Decimal/Hexadecimal Calculations

EXAMPLE	OPERATION	READ-OUT
	[MODE] [1] (BASE-N mode)	
$10111_2 + 11010_2 = 110001_2$		
	[SHIFT] [BIN] **10111** [+] **11010** [=]	110001.^{b}
$123_8 \times ABC_{16} = 37AF4_{16}$		
$= 228084_{10}$		
	[SHIFT] [OCT] **123** [×] [HEX] **ABC** [=]	37AF4.^{H}
	[DEC]	228084.^{d}

$1F2D_{16} - 100_{10} = 7881_{10}$
$= 1EC9_{16}$

[HEX] **1F2D** [−] [DEC] **100** [=] 7881.^{d}

[HEX] 1EC9.^{H}

$7654_{8} \div 12_{10} = 334.3..._{10}$
$= 516_{8}$

[SHIFT] [OCT] **7654** [÷] [DEC] **12** [=] 334.^{d}

[SHIFT] [OCT] 516.^{o}

Fractional parts of calculation results are truncated.

$110_{2} + 456_{8} \times 78_{10} \div 1A_{16} = 390_{16}$
$= 912_{10}$

[SHIFT] [BIN] **110** [+] [SHIFT] [OCT] **456**
[×] [DEC] **78** [÷] [HEX] **1A** [=] 390.^{H}

[DEC] 912.^{d}

$BC_{16} \times (14_{10} + 69_{10}) = 15604_{10}$
$= 3CF4_{16}$

[HEX] **BC** [×] [(] [DEC] **14** [+] **69**
[)] [=] 15604.^{d}

[HEX] 3CF4.^{H}

Using Memory

EXAMPLE	OPERATION	READ-OUT
$\underline{23_{8}} + 963_{10} = 982_{10}$		
[SHIFT] [OCT] **23** [Min] [+] [DEC] **963** [=]	M	982.^{d}

$\underline{23_8} + 101011_2 = 111110_2$

MR + SHIFT BIN **101011** = M 111110.^{b}

$2A56_{16} \times \underline{23_8} = 32462_{16}$

HEX **2A56** × MR = M 32462.^{H}

Logical Operations

Use the NOT, AND, OR, XOR, and XNOR keys to perform logical operations.

EXAMPLE	OPERATION	READ-OUT

MODE 1 (BASE-N mode)

NOT of 10110_2

SHIFT BIN **10110** NOT 1111101001.^{b}

NOT of 1234_8

SHIFT OCT **1234** NOT 7777776543.^{o}

NOT of $2FFFED_{16}$

HEX **2FFFED** NOT FFd00012.^{H}

19_{16} AND $1A_{16} = 18_{16}$

HEX **19** AND **1A** = 18.^{H}

1110_2 AND $36_8 = 1110_2$

SHIFT BIN **1110** AND SHIFT OCT **36** = 16.^{o}

SHIFT BIN 1110.^{b}

23_8 OR $61_8 = 63_8$

SHIFT OCT **23** OR **61** = 63.^{o}

120_{16} OR $1101_2 = 12D_{16}$

HEX **120** OR SHIFT BIN **1101** = 100101101.^{b}

HEX 12d.^{H}

5_{16} XOR $3_{16} = 6_{16}$

HEX **5** XOR **3** = 6.^{H}

$2A_{16}$ XNOR $5D_{16} = FFFFFF88_{16}$

HEX **2A** XNOR **5D** = FFFFFF88.^{H}

1010_2 AND (A_{16} OR 7_{16}) = 1010_2

SHIFT BIN **1010** AND ((HEX **A** OR **7**

)) = A.^{H}

SHIFT BIN 1010.^{b}

Using Constants

EXAMPLE	OPERATION	READ-OUT
$1A_{16}$ AND $2F_{16} = A_{16}$	HEX **2F** AND AND **1A** =	A.^{H}
$3B_{16}$ AND $2F_{16} = 2B_{16}$	**3B** =	2b.^{H}

DIGITAL NOTATION AND DEGREE-MINUTE-SECOND NOTATION

The calculator allows you to enter angle and time measurements in the units you usually use to measure them (degrees/hours, minutes, seconds). Your calculator uses a decimal system to perform calculations. Then, the result of your calculation is displayed in digital notation, which you can then convert to DMS (degree-minute-second) notation.

Use the [o,,,] and [SHIFT] [o,,,] keys. To enter a value using DMS notation, enter the degree (or hour), press [o,,,], enter the minute, press [o,,,] again, and then enter the second and press [o,,,]. As you enter the value, the calculator automatically converts to digital notation.

To change the value on the display to DMS notation, press [SHIFT] [o,,,].

14°25'36'' =	**14** [o,,,]	14.
	25 [o,,,]	14.41666667
	36 [o,,,]	14.42666667
	[SHIFT] [o,,,]	14 ▫ 25 ▫ 36.

ANGULAR MODES

You must set the angular mode you wish to use for trigonometric functions and polar/rectangular coordinate conversions.

Setting the angular mode:

Press	To set to	Display
MODE 4	degree	D
MODE 5	radian	R
MODE 6	grad	G

FUNCTION CALCULATIONS

The calculator performs function calculations only in the COMP mode (MODE 0) unless otherwise noted. Some functions require time for calculation. Do not press any keys while a calculation is in progress.

Note: The display goes blank during calculations.

Trigonometric Functions

Calculation range

$\sin x/\cos x/\tan x$	$\lvert x\rvert < 9\times10^{9}$ degrees ($<5\times10^{7}\pi$ rad, $<1\times10^{10}$ gra)
$\sin^{-1}x/\cos^{-1}x$	$\lvert x\rvert \leqq 1$
$\tan^{-1}x$	$\lvert x\rvert < 10^{100}$

Accuracy

± 1 in the 10th digit

EXAMPLE	OPERATION	READ-OUT
$\sin(\frac{\pi}{6}\text{rad}) =$		
	"R" (MODE 5)	
	π ÷ 6 = sin	0.5
$\cos 63°52'41'' =$		
	"D" (MODE 4)	
	63 °'" 52 °'" 41 °'"	63.87805556
	cos	0.440283084
$\tan(-35\,\text{gra}) =$		
	"G" (MODE 6) 35 +/- tan	−0.612800788
$2 \cdot \sin 45° \times \cos 65° =$		
	"D" 2 × 45 sin × 65	
	cos =	0.597672477
$\cot 30° = \frac{1}{\tan 30°} =$		
	"D" 30 tan 1/x	1.732050808
$\sec(\frac{\pi}{3}\text{rad}) = \frac{1}{\cos(\frac{\pi}{3}\text{rad})} =$		
	"R" π ÷ 3 = cos 1/x	2.
$\text{cosec}\,30° = \frac{1}{\sin 30°} =$		
	"D" 30 sin 1/x	2.
$\cos^{-1}\frac{\sqrt{2}}{2} =$		
	"R" 2 √ ÷ 2 = SHIFT cos	0.785398163

$\tan^{-1}0.6104 =$

"D".6104 [SHIFT] [tan'] 31.39989118

[SHIFT] [o,,,] 31°23°59.61

Hyperbolic Functions

Calculation Range

$\sinh x/\cosh x$	$\lvert x\rvert \leqq 230.2585092$
$\tanh x$	$\lvert x\rvert < 10^{100}$
$\sinh^{-1}x$	$\lvert x\rvert < 5 \times 10^{99}$
$\cosh^{-1}x$	$1 \leqq x < 10^{99}$
$\tanh^{-1}x$	$\lvert x\rvert < 1$

Accuracy

±1 in the 10th digit

hyp appears on the display when you press [hyp].

EXAMPLE	OPERATION	READ-OUT
$\sinh 3.6 =$	**3.6** [hyp] [sin]	18.28545536
$\tanh 2.5 =$	**2.5** [hyp] [tan]	0.986614298
$\cosh 1.5 - \sinh 1.5 =$		
	1.5 [Min] [hyp] [cos] [−]	M 2.352409615
	[MR] [hyp] [sin] [=]	M 0.22313016
	[In]	M −1.5
$\sinh^{-1}30 =$	**30** [SHIFT] [hyp] [sin']	4.094622224

Solve $\tanh 4x = 0.88$.

$$x = \frac{\tanh^{-1} 0.88}{4} =$$

.88 SHIFT hyp tan^{-1} ÷ **4** = 0.343941914

Logarithms/Exponentations

Calculation Range

$\log x / \ln x$	$10^{-99} \leqq x < 10^{100}$
e^x	$-10^{100} < x \leqq 230.2585092$
10^x	$-10^{100} < x < 100$

Accuracy

±1 in 10th digit

EXAMPLE	OPERATION	READ-OUT
$\log 1.23 (= \log_{10} 1.23) =$	**1.23** log	0.089905111
$\ln 90 (= \log e 90) =$	**90** ln	4.49980967
$\log 456 \div \ln 456 =$	**456** Min log ÷ MR ln =	M 0.434294481
$10^{0.4} + 5.e^{-3} =$	**.4** SHIFT 10^x + **5** × **3** +/− SHIFT e^x =	2.760821773

Squares/Square Roots/Cube Roots

Calculation Range

$\sqrt{x}$	$0 \leqq x < 10^{100}$
x^2	$\lvert x \rvert < 10^{50}$
$\sqrt[3]{x}$	$\lvert x \rvert < 10^{100}$

Accuracy
±1 in the 10th digit

EXAMPLE	OPERATION	READ-OUT
$\sqrt{2}+\sqrt{3}\times\sqrt{5}=$		
	2 √ **+** **3** √ **×** **5** √ **=**	5.287196909
$123+30^2=$		
	123 **+** **30** x^2 **=**	1023.
$\sqrt[3]{5}+\sqrt[3]{-27}=$		
	5 SHIFT $\sqrt[3]{}$ **+** **27** +/− SHIFT $\sqrt[3]{}$ **=**	−1.290024053

Powers/Roots

Calculation Range

x^y $\begin{cases} x>0\text{: } -10^{100}<y\cdot\log x<100 \\ x=0\text{: } y>0 \\ x<0\text{: } y\text{: integer or } \pm 1/2n+1 \\ \qquad (n\text{: integer}) \end{cases}$

$x^{1/y}$ $\begin{cases} x>0\text{: } y\neq 0\ -10^{100}<1/y\cdot\log x<100 \\ x=0\text{: } y>0 \\ x<0\text{: } y\text{: odd number or } \pm 1/n \\ \qquad (n\text{: natural number}) \end{cases}$

Accuracy
±1 in the 10th digit.

EXAMPLE	OPERATION	READ-OUT
$5.6^{2.3}=$	**5.6** x^y **2.3** **=**	52.58143837
$123^{1/7}\ (=\sqrt[7]{123})=$		
	123 SHIFT $x^{1/y}$ **7** **=**	1.988647795
$(78-23)^{-12}=$		
	((··· **78** **−** **23** ···)) x^y **12** +/− **=**	1.305111829^{-21}

x^y and $x^{1/y}$ can be registered as a constant.

$4^{2.5} =$ **2.5** x^y x^y **4** = K 32.

$0.16^{2.5} =$ **.16** = K 0.01024

$9^{2.5} =$ **9** = K 243.

Reciprocals

Calculation Range

$1/x$ $\quad |x| < 10^{100}$ $(x \neq 0)$

Accuracy

±1 in the 10th digit.

EXAMPLE	OPERATION	READ-OUT
$\dfrac{1}{\frac{1}{3}-\frac{1}{4}} =$	**3** 1/x **−** **4** 1/x = 1/x	12.

Factorials

Calculation Range

$x!$ $\quad 0 \leqq x \leqq 69$ (x: integer)

Accuracy

±1 in the 10th digit.

EXAMPLE	OPERATION	READ-OUT
$8!(=1\times2\times3\times\ldots\ldots\times7\times8) =$	**8** SHIFT x!	40320.

Random Numbers

Generates a random number in the range 0.000 to 0.999

[SHIFT] [RAN#] 0.570
(Example)

Rectangular/Polar Coordinates

Calculation Range

REC→POL $\sqrt{x^2+y^2} < 10^{100}$

POL→REC $|\theta| < 9 \times 10^9$ degrees $\left(< 5 \times 10^7 \pi \text{ rad}, < 10^{10} \text{ gra}\right)$
$0 \leqq r < 10^{100}$

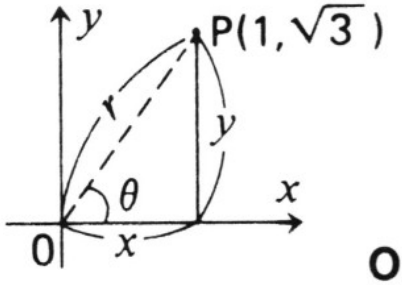
Accuracy

±1 in the 10th digit.

Formula: $r = \sqrt{x^2+y^2}$

$$\theta = \tan^{-1}\frac{y}{x} \quad (-180° < \theta \leqq 180°)$$

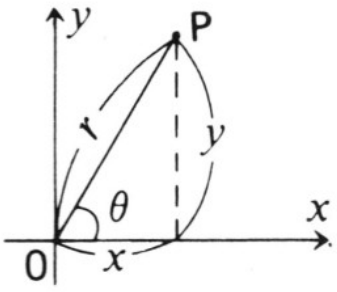
Find the length r and angle θ in radians for the point $x=1$ and $y=\sqrt{3}$.



OPERATION	READ-OUT
"R" ([MODE] [5])	
1 [SHIFT] [R→P] 3 [√] [=]	2. = r
[SHIFT] [X↔Y]	1.047197551 = θ (θ in radian)

Formula: $x = r \cdot \cos\theta \quad y = r \cdot \sin\theta$

Find the value of x and y for the point $\theta = 60°$ and length $r = 2$.



OPERATION	READ-OUT
"D" (MODE 4)	
2 SHIFT P→R 60 =	1. = x
SHIFT X↔Y	1.732050808 = y

Permutations/Combinations

Calculation Range

nPr/nCr $0 \leqq r \leqq n$, $n < 10^{10}$
(n, r: positive integer)

*Certain combinations or permutations can cause errors due to overflow during internal calculations.

Accuracy

±1 in the 10th digit

How many numbers of 4 figures can be obtained when permuting 4 different numbers among 7 (1 to 7)?

OPERATION	READ-OUT
7 SHIFT nPr 4 =	840.

How many groups of 4 members can be obtained when there are ten in class?

10 SHIFT nCr 4 =	210.

COMPLEX NUMBERS

To select the complex number mode, press MODE EXP. CMPLX appears on the display. To exit the complex number mode, select any other mode (except ENG).

The complex number calculation uses the constant memories. When you enter the complex number mode, the constant memories clear. You cannot use constant memory while you are in the complex number mode.

Calculation Range

Addition/subtraction

$|A \pm C| < 10^{100}$

$|B \pm D| < 10^{100}$

Multiplication

$|AC| < 10^{100}$

$|BD| < 10^{100}$

$|AC - BD| < 10^{100}$

$|BC| < 10^{100}$

$|AD| < 10^{100}$

$|BC + AD| < 10^{100}$

Division

$|AC| < 10^{100}$

$|BD| < 10^{100}$

$|AC + BD| < 10^{100}$

$|BC| < 10^{100}$

$|AD| < 10^{100}$

$|BC - AD| < 10^{100}$

Calculation Limits: Nesting of up to 9 levels, parentheses of up to 3 levels.

* Press [SHIFT] [i] [=] after entering the imaginary part of the number. Note that the complex number entry completes as you press [=]. If you do not press [=] and proceed to next calculation, only the imaginary part is calculated.

Example:

$1 + 3i \times 3 = 1 + 9i$

1 [+] 3 [SHIFT] [i] [×] 3 [=] 1.
[SHIFT] [Re↔Im] 9.**i**

$(1 + 3i) \times 3 = 3 + 9i$

1 [+] 3 [SHIFT] [i] [=] [×] 3 [=] 3.
[SHIFT] [Re↔Im] 9.**i**

If you press [+/−] before you press [=], the sign of imaginary part changes. If you press [+/−] after pressing [=], the sign of both the real part and imaginary part changes.

* When R ◆ I appears on the display with the calculation result, it indicates that the result has also an imaginary number part. Press [Re↔Im] or [SHIFT] [Re↔Im] to display the imaginary number part. Press the same key(s) to return to real number part.

$1.23 + 4.56i = 1.23 + 4.56i$

1.23 [+] 1.23

4.56 [SHIFT] [i] 4.56**i**

[=] 1.23

(real number part)

[SHIFT] [Re↔Im] 4.56**i**

(imaginary number part)

$1.2 \times 10^{14} + 3.4i = 1.2 \times 10^{14} + 3.4i$

1.2 [EXP] **14** [+] **3.4** [SHIFT] [i] [=] 1.2^{14}

[SHIFT] [Re↔Im] 3.4**i**

You can use constant calculations, fractions, standard memory, and advanced functions in this mode. However, you can only perform the following functions in the complex number mode if the number does not have an imaginary part.

trigonometrics, hyperbolics, logarithms, exponentials, powers, roots, polar-rectangular conversions, degree-minute-second, and decimal degree conversions

If you attempt any of above when the number has an imaginary part, the error symbol appears.

$2/5i$ **2** [a b/c] **5** [SHIFT] [i] [=] 2/5**i**

$1/(1 + 2i) = 0.2 - 0.4i$

1 [+] **2** [SHIFT] [i] [=] [1/x] 0.2

[SHIFT] [Re↔Im] -0.4**i**

The priority of calculations is the same as in real number-only calculations.

$8 \times 2i - 18 \div 3i = 22i$

8 × 2 SHIFT i − 18 ÷ 3 SHIFT i = 22.i

$8 + (4 + 8i) = 12 + 8i$

$3 \times (4 + 8i) = 12 + 24i$

8 + ((4 + 8 SHIFT i)) Min = 12.

SHIFT Re↔Im 8.i

3 × MR = 12.

SHIFT Re↔Im 24.i

Pressing SHIFT i without entering a number enters $1i$. You can use this feature to enter a calculation result as imaginary part. For example, to calculate $((-1 + \sqrt{3}i)/2)^3$:

1 +/− + SHIFT i × 3 √ =

÷ 2 = −0.5

SHIFT Re↔Im 0.866025403i

× × = = 1.

Notes:

- Be sure to press = before storing a complex number into memory. If you don't, only the imaginary part of the number is stored into memory.
- When you exit the complex number mode, only the real number part is retained in the memory.
- You still get an error display if you try to calculate the square root of a negative number in complex number mode.

Arguments and Absolute Values

Use [SHIFT] [arg] to obtain the argument (or amplitude) of a complex number. Verify to change the angular mode before pressing [SHIFT] [arg]. Press [|z|] to obtain the absolute value (module).

How many degrees is the argument of $5 + 8i$?

"D" [MODE] [4]

5 [+] 8 [SHIFT] [i] [=] [SHIFT] [arg] 57.99461679

What is the absolute value?

[SHIFT] [|z|] 9.433981132

STATISTICAL CALCULATIONS

In statistical calculations, the calculator stores various calculation results in constant memories. If you store a value in any constant memory, it is changed after a statistical calculation. To avoid any errors, press [SHIFT] [KAC] before performing statistical calculations.

Means and Standard Deviation

To select the standard deviation mode, press [MODE] [3]. SD appears on the display.

Entering Data

Enter data, and press [DATA].

Obtaining Answers

Press	To obtain
SHIFT $x\sigma_{n-1}$	Sample standard deviation
SHIFT $x\sigma_n$	Population standard deviation
SHIFT $\bar{x}$	Arithmetic mean
Kout 3 (n)	Number of data
Kout 2 (Σx)	Sum of data
Kout 1 (Σx^2)	Sum of square of data

Find σ_{n-1}, σ_n, $\bar{x}$, n, Σx and Σx^2 based on the data 55, 54, 51, 55, 53, 53, 54, 52.

	OPERATION	READ-OUT
"SD"	SHIFT KAC **55** DATA **54** DATA **51** DATA **55** DATA **53** DATA **53** DATA **54** DATA **52** DATA	52.
(Sample standard deviation)	SHIFT $x\sigma_{n-1}$	1.407885953
(Population standard deviation)	SHIFT $x\sigma_n$	1.316956719
(Arithmetical mean)	SHIFT $\bar{x}$	53.375
(Number of data)	Kout 3 (n)	8.
(Sum of value)	Kout 2 (Σx)	427.
(Sum of square value)	Kout 1 (Σx^2)	22805.

Calculate the unbiased variance and the deviation between each data and the average.

(Subsequently)

SHIFT $x\sigma_{n-1}$ x^2	1.982142857 (Unbiased variance)
SHIFT $\bar{x}$ − − 55 =	1.625 $(55-\bar{x})$
54 =	0.625 $(54-\bar{x})$
51 =	−2.375 $(51-\bar{x})$
⋮	⋮

To enter the frequency of data, use the × key.

The finished diameter of rods were found to be dispersed in the following manner:

Group	Median	Frequency
1	8.1	9
2	8.2	19
3	8.3	28
4	8.4	12
5	8.5	7

Obtain the standard deviation and arithmetic mean.

OPERATION	READ-OUT
[SHIFT] [KAC] **8.1** [×] **9** [DATA] **8.2** [×]	
19 [DATA]	8.2
8.3 [×] **28** [DATA] **8.4** [×] **12**	
[DATA] **8.5** [×] **7** [DATA]	8.5
Standard deviation [SHIFT] [$x\sigma_n$]	0.111586538
Arithmetic mean [SHIFT] [$\bar{x}$]	8.285333333

Correcting Mistakes

If you discover your mistakes before you press [DATA], press [C]. Then enter the correct number(s). You can use [►] to correct the last digit.

If you discover a mistake immediately after pressing [DATA], press [SHIFT] [DEL]. This deletes the last piece of data that was entered.

To delete incorrect data that you entered several steps ago, enter the incorrect data again and press [SHIFT] [DEL].

Find n, $\bar{x}$ & σ_{n-1} based on the data: 1.2, −0.9, −1.5, 2.7, −0.6, 0.5, 0.5, 0.5, 0.5, 1.3, 1.3, 1.3, 0.8, 0.8, 0.8, 0.8, 0.8.

	OPERATION	READ-OUT
"SD"	SHIFT KAC 1.2 DATA .9 +/- DATA	−0.9
① (Mistake)	2.5 +/-	−2.5
①' (To correct)	C	0.
	1.5 +/- DATA	−1.5
	2.7 DATA	2.7
② (Mistake)	DATA	2.7
③ (Mistake)	1.6 +/- DATA	−1.6
③' (To correct)	SHIFT DEL	−1.6
	.6 +/- DATA	−0.6
②' (To correct)	2.7 SHIFT DEL	2.7
	.5 ×	0.5
	4 DATA	0.5
④ (Mistake)	1.4 ×	1.4
④' (To correct)	AC	0.
	1.3 × 3 DATA	1.3
	.8 ×	0.8
⑤ (Mistake)	6 DATA	0.8
⑤' (To correct)	.8 × 6 SHIFT DEL	0.8
	.8 × 5 DATA	0.8
	Kout 3 (n)	17.
	SHIFT $\bar{x}$	0.635294117
	SHIFT $x\sigma_{n-1}$	0.95390066

Regression Analysis

By using the linear formulas built into your calculator, you can do linear regression, logarithmic regression, exponential regression, and power regression.

Press [MODE] [2] to select the linear regression mode. LR appears on the display.

Formulas:
Linear regression: $y = A + Bx$
Logarithmic regression: $\hat{y} = A + B\ln x$
Exponential regression:

$$\hat{y} = Ae^{Bx} \text{ or } \ln y = \ln A + Bx$$

Power regression:

$$\hat{y} = Ax^{B} \text{ or } \ln y = \ln A + B\ln x$$

Entering Data

Enter x data, press [x_D,y_D], enter y data, press [DATA].

Correcting Mistakes

If you enter an incorrect x value and catch the mistake before you press [x_D,y_D], press [C] and enter correct value. If you have pressed [x_D,y_D] before you catch the error, enter the correct value, press [x_D,y_D] again, and continue.

If you enter an incorrect y value and notice it before pressing [DATA], press [C] and enter the correct value. If you enter x and/or y value incorrectly and do not catch it before pressing [DATA], simply press [SHIFT] [DEL]. This deletes the data pair you just entered. Re-enter both x and y correctly.

If you enter several other data pairs before realizing your mistake, enter the incorrect x value, press [x_D,y_D], enter the incorrect y value, and press [SHIFT] [DEL]. Now, enter the correct pair.

Obtaining Answers

Press	To obtain
[Kout] [1] (Σx^2)	Sum of the square of x
[Kout] [2] (Σx)	Sum of x
[Kout] [3] (n)	Number of data
[Kout] [Σy^2]	Sum of the square of y
[Kout] [Σy]	Sum of y
[Kout] [Σxy]	Sum of the products of data
[SHIFT] [$\bar{x}$]	Mean of x
[SHIFT] [$x\sigma_n$]	Population standard deviation of x
[SHIFT] [$x\sigma_{n-1}$]	Sample standard deviation of x
[SHIFT] [$\bar{y}$]	Mean of y
[SHIFT] [$y\sigma_n$]	Population standard deviation of y
[SHIFT] [$y\sigma_{n-1}$]	Sample standard deviation of y
[SHIFT] [A]	Constant term
[SHIFT] [B]	Regression coefficient
[SHIFT] [r]	Correlation coefficient
[SHIFT] [$\hat{x}$]	Estimated value of $\hat{x}$
[$\hat{y}$]	Estimated value of $\hat{y}$

You can enter any number of data items. The calculator automatically calculates the constant term, regression coefficient, and correlation coefficient for the input data pair. It stores only these numbers in its memory. The calculator does not store the data you input.

Linear Regression

Results from measuring the length and temperature of a steel bar.

temp.	length
10°C	1003mm
15	1005
20	1010
25	1008
30	1014

Find the constant term (A), regression coefficient (B), correlation coefficient (r) and estimated values ($\hat{x}$, $\hat{y}$) using the above figures as a basis.

	OPERATION	READ-OUT
"LR"	SHIFT KAC **10** x_D,y_D	10.
	1003 DATA	1003.
	15 x_D,y_D **1005** DATA	1005.
	20 x_D,y_D **1010** DATA	1010.
	25 x_D,y_D **1008** DATA	1008.
	30 x_D,y_D **1014** DATA	1014.
	SHIFT A	998. (A)
	SHIFT B	0.5 (B)
	SHIFT r	0.919018277 (r)

(When the temperature is 18°C)

	18 $\hat{y}$	1007. (mm)

(When the length is 1000mm)

	1000 SHIFT $\hat{x}$	4. (°C)

Logarithmic Regression

When you enter the natural logarithm of the x data instead of x itself, you can calculate logarithmic regression.

To estimate the $\hat{y}$ value based on x, enter x, press [ln], and then press [$\hat{y}$]. To estimate the $\hat{x}$ value from y, enter y, press [SHIFT] [$\hat{x}$] then press [SHIFT] [e^x].

xi	29	50	74	103	118
yi	1.6	23.5	38.0	46.4	48.9

Find A, B, r, $\hat{x}$ and $\hat{y}$ using the above figures as a basis.

	OPERATION	READ-OUT
"LR"	[SHIFT] [KAC] **29** [ln] [x_D,y_D]	3.36729583
	1.6 [DATA]	1.6
	50 [ln] [x_D,y_D] **23.5** [DATA]	23.5
	74 [ln] [x_D,y_D] **38** [DATA]	38.
	103 [ln] [x_D,y_D] **46.4** [DATA]	46.4
	118 [ln] [x_D,y_D] **48.9** [DATA]	48.9
	[SHIFT] [A]	−111.1283976 (A)
	[SHIFT] [B]	34.02014749 (B)
	[SHIFT] [r]	0.994013946 (r)
(When xi is 80)		
	80 [ln] [$\hat{y}$]	37.94879482 ($\hat{y}$)
(When yi is 73)		
	73 [SHIFT] [$\hat{x}$] [SHIFT] [e^x]	224.1541314 ($\hat{x}$)

Exponential Regression

Input the y data as the natural logarithm of the actual data y to calculate exponential regression. To obtain coefficient A, press [SHIFT] [A] [SHIFT] [e^x]. To estimate the $\hat{y}$ value based on x, enter x, press [$\hat{y}$], then press [SHIFT] [e^x]. To estimate the value of $\hat{x}$ based on y, enter y, press [ln], and press [SHIFT] [$\hat{x}$].

xi	6.9	12.9	19.8	26.7	35.1
yi	21.4	15.7	12.1	8.5	5.2

Find A, B, r, $\hat{x}$ and $\hat{y}$ using the above figures as a basis.

	OPERATION	READ-OUT
"LR"	[SHIFT] [KAC] **6.9** [x_D,y_D]	6.9
	21.4 [ln] [DATA]	3.063390922
	12.9 [x_D,y_D] **15.7** [ln] [DATA]	2.753660712
	19.8 [x_D,y_D] **12.1** [ln] [DATA]	2.493205453
	26.7 [x_D,y_D] **8.5** [ln] [DATA]	2.140066163
	35.1 [x_D,y_D] **5.2** [ln] [DATA]	1.648658626
	[SHIFT] [A] [SHIFT] [e^x]	30.49758742 (A)
	[SHIFT] [B]	−0.049203708 (B)
	[SHIFT] [r]	−0.997247351 (r)
(When xi is 16)		
	16 [$\hat{y}$] [SHIFT] [e^x]	13.87915739 ($\hat{y}$)
(When yi is 20)		
	20 [ln] [SHIFT] [$\hat{x}$]	8.574868046 ($\hat{x}$)

Power Regression

For power regression calculations, input the natural logarithm of both the x and y data. To obtain coefficient A, press [SHIFT] [A] [SHIFT] [e^x]. To estimate the $\hat{y}$ value based on x, enter x, press [ln], press [$\hat{y}$], and then press [SHIFT] [e^x]. To estimate the $\hat{x}$ value based on y, enter y, press [ln], and then press [SHIFT] [$\hat{x}$] [SHIFT] [e^x].

xi	28	30	33	35	38
yi	2410	3033	3895	4491	5717

Find A, B, r, $\hat{x}$ and $\hat{y}$ using the above figures as a basis.

	OPERATION	READ-OUT
"LR"	[SHIFT] [KAC] **28** [ln] [x_D,y_D]	3.33220451
	2410 [ln] [DATA]	7.787382026
	30 [ln] [x_D,y_D] **3033** [ln] [DATA]	8.017307508
	33 [ln] [x_D,y_D] **3895** [ln] [DATA]	8.267448958
	35 [ln] [x_D,y_D] **4491** [ln] [DATA]	8.409830673
	38 [ln] [x_D,y_D] **5717** [ln] [DATA]	8.651199471
	[SHIFT] [A] [SHIFT] [e^x]	0.238801092 (A)
	[SHIFT] [B]	2.771866138 (B)
	[SHIFT] [r]	0.998906254 (r)
(When xi is 40)		
	40 [ln] [$\hat{y}$] [SHIFT] [e^x]	6587.674777 ($\hat{y}$)
(When yi is 1000)		
	1000 [ln] [SHIFT] [$\hat{x}$] [SHIFT] [e^x]	20.26225651 ($\hat{x}$)

MAINTENANCE

Your EC-4032 is an example of superior design and craftsmanship. The following suggestions will help you care for the EC-4032 so that you can enjoy it for years.

Keep the EC-4032 dry. If it does get wet, wipe it dry immediately. Liquids can contain minerals that can corrode the electronic circuits.

Your calculator's lithium battery should last throughout the life of your product. If, however, the calculator loses memory contents when it is not exposed to light, the battery must be replaced. Take your calculator to your local Radio Shack store for battery replacement assistance.

Handle the EC-4032 gently and carefully. Dropping it can damage circuit boards and cases and can cause the calculator to work improperly.

Use and store the EC-4032 only in normal temperature environments. High temperatures can shorten the life of electronic devices, damage batteries, and distort or melt plastic parts.

Keep the EC-4032 away from dust and dirt, which can cause premature wear of parts.

Wipe the EC-4032 with a dampened cloth occasionally to keep it looking new. Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the EC-4032.

Modifying or tampering with the EC-4032's internal components can cause a malfunction and might invalidate the EC-4032's warranty. If your EC-4032 is not performing as it should, take it to your local Radio Shack store. Our personnel can assist you and arrange for service if needed.

SPECIFICATIONS

BASIC OPERATIONS

4 basic calculations, constants for + / − / × / ÷ / x^y / $x^{1/y}$ / AND / OR / XOR / XNOR, parenthesis calculations and memory calculations.

BUILT-IN FUNCTIONS

Trigonometric / inverse trigonometric functions (with angle in degrees, radians or grads), hyperbolic / inverse hyperbolic functions, common / natural logarithms, exponential functions (common antilogarithms, natural antilogarithms), powers, roots, square roots, cube roots, squares, reciprocals, factorials, engineering unit calculations, conversion of coordinate system (R→P, P→R), permutations, combinations, random number, π, fractions, percentages, binary, octal, decimal, and hexadecimal calculations, logical operations and complex number calculations.

STATISTICAL FUNCTIONS

Standard deviation, linear regression, logarithmic regression, exponential regression, and power regression.

MEMORY

1 independent memory and 6 constant memories.

DECIMAL POINT

Full floating with underflow.

READ-OUT

Liquid crystal display, suppressing unnecessary 0's (zeros).

POWER SOURCE

Solar cell, lithium battery
Lithium battery life: 6 years (1-hour daily use).

AMBIENT TEMPERATURE RANGE

32°F — 104°F (0°C — 40°C)

DIMENSIONS

$^{3}/_{4} \times 2^{7}/_{8} \times 5^{1}/_{2}$ inches (HWD)
(16.5mm (H) × 73mm (W) × 140mm(D))

WEIGHT

2.3 oz (66 g)

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This product is warranted against defects for 1 year from date of purchase from Radio Shack company-owned stores and authorized Radio Shack franchisees and dealers. Within this period, we will repair it without charge for parts and labor. Simply **bring your Radio Shack sales slip** as proof of purchase date to any Radio Shack store. Warranty does not cover transportation costs. Nor does it cover a product subjected to misuse or accidental damage.

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